REHABILITATION OUTCOME OF BILATERAL LOWER LIMB AMPUTEES

DISSERTATION SUBMITTED TO

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY

FOR

M.D.BRANCH – XIX- PHYSICAL MEDICINE AND REHABILITATION

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CONTENTS

INTRODUCTION

The loss of both lower limbs complicates the rehabilitation process, especially if the loss occurs simultaneously. In developing countries like INDIA, the incidence of simultaneous limb loss is more frequent. Vascular disease affects both limb, Hence, patients with a single dysvascular amputation face a significant risk of eventual bilateral limb loss. When compared to single artificial limb, using two artificial limb is physically more difficult. Training, like prosthetic fitting must be individualized for each patient, taking into account physical condition, biomechanical loss and prosthetic characteristics.

Person with bilateral lower limb amputations has presented a special challenge for the rehabilitation team to provide a degree of mobility that would allow a more normal place in society. Bilateral congenital Leg amputations and limb deficiencies encompasses a small but often difficult group.

Bilateral limb Amputation may be of the same level such as foot, ankle, transtibial, transfemoral etc or any limb combination of these.

AIM OF STUDY

Rehabilitation outcome of Bilateral lower limb Amputees of different etiology, age group, levels and combination at Government Institute of Rehabilitation Medicine, K.K. Nagar, Chennai.

REVIEW OF LITERATURE

HISTORY

An **AMPUTATION** (AMB1 = Around, PUTATIO = Trimming) is the removal of a limb or other appendage or outgrowth of the body. **DISARTICULATION** involves amputation through a joint. The portion of the limb that remains after amputation is known as the RESIDUAL LIMB.

A PROSTHESIS is the manufactured device that allows the person with an amputation to regain function.

The earliest amputations usually resulted in death from shock caused by blood loss or septicemia. Those who survived the operation itself often died in the early post operative period because of infection and gangrene. When antisepsis and anaesthesia came into use in the mid 19th century, Specific surgical techniques, tissue conservation and post operative management became the focus of amputation surgery.

Ambrose pare is called the founder of modern surgery.

First prosthesis was given to Hegistratus in 484 BC.

First Hip disarticulation was done by William kerr of England in 1744

Tarso – metatarsal disarticulation was done by LIS FRANC'S a French surgeon in 1815.

Disarticulation of ankle by James Symes at Edinburgh in 1843

Antiseptic technique was introduced by LORD LISTER in 1867.

Myoplasty was introduced by Burgess in 1956. Myodeisis was advocated by Weiss in 1960's

Immediate Post-operative Prosthesis was first fitted by Michael Berlemont in 1958.

Canadian hip disarticulation Prosthesis was designed at sunny Brook Hospital, Toronto in 1954. In 1955, Canadian Syme's Prosthesis designed at the same hospital.

SACH foot was introduced by University of California in 1955.

In India first artificial limb centre was started in Defense Medical College, Pune. Following that artificial limb centre was started in Chennai in 1965.

In 1970, The U.S. Veterans Administration develops the endoskeletal prosthesis.

In 2000, A microprocessor controlled knee with hydraulic swing and stance phase control is developed.

EPIDEMIOLOGY

Bilateral lower – limb amputations are much more frequent currently than in the past largely secondary to an aging population with an increased incidence of peripheral vascular disease and Diabetes mellitus.

30 to 50% of the individual with diabetic and peripheral vascular disease lose their contralateral limb within five years of first limb amputation.

In India, among the all lower limb amputations 5 to 10% is constituted by the bilateral lower limb amputation.

ETIOPATHOLOGY

i. VASCULAR

Peripheral Vascular Disease

- Raynaud's disease,Buerger's Disease, Atherosclerosis, Frost Bite, Diabetes Mellitus

ii. Traumatic

Road Traffic Accidents

Train Accidents

Natural Disasters

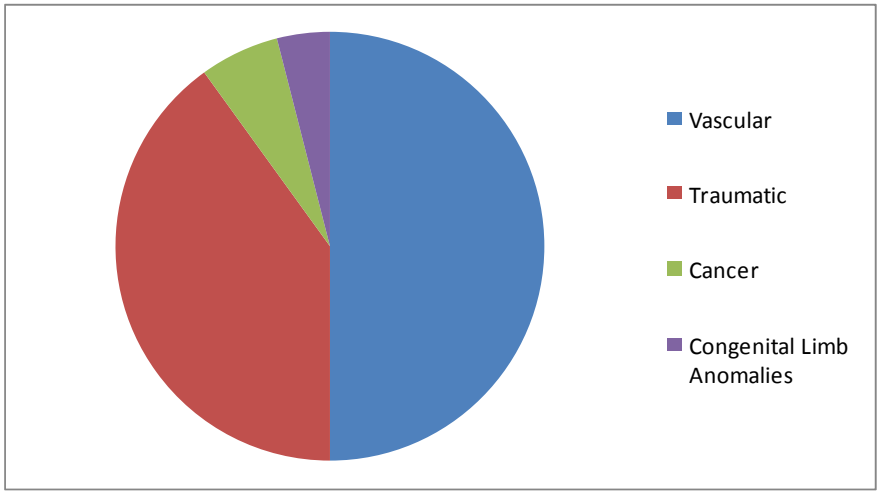
War

Severe Burns

iii. Infections – Leprosy

iv. Cancer – Related Amputations

v. Congenital Limb anomalies



INVESTIGATIONS

Vascular Etiology -

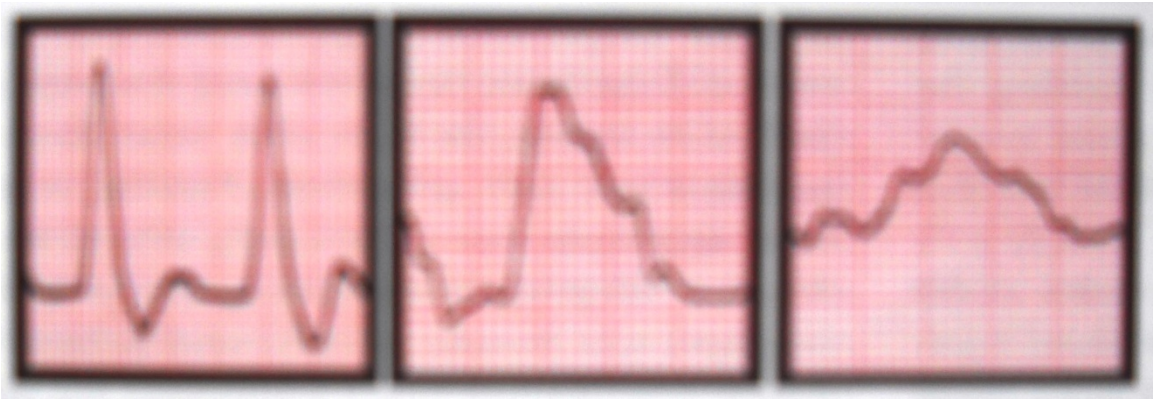
I) Hemodynamic assessment of lower – level arterial circulation

PHOTOPLETHYSMOGRAPHY

Photoplethysmography employs a transducer that transmits infrared light from an emitting diode into the tissue. Part of the transmitted light is reflected back from the blood within the cutaneous microcirculation and the amount of reflected light varies with the blood content of the microcirculation. The pressure at which the waveform obliterates corresponds to the digital systolic pressure.

DOPPLER ULTRASOUND

Doppler Ultrasound devices consists of two piezoelectric crystals mounted in a probe. By stimulating one of the crystals with an electrical charge. Sound waves of various frequencies are emitted. The second crystals receives the sound waves reflected from moving particles, producing a voltage change. This change can be amplified and converted to analogue wave forms or sound. A frequency of 5 MHZ is suited for monitoring deep blood vessel flow in the vena cava or iliac veins or for examining peripheral veins. A frequency of 10 MHz is ideal for blood velocity detection in arteries in the lower leg arms and digits. The Doppler probe is coupled to the skin with acoustic gel and held at an appropriate a vessel being examined. (Angle ranging from 38 to 52 degrees).



Normal **Claudication** **Rest Pain**

SEGMENTAL PRESSURE:

Pressure cuffs 12 cm wide are placed at the high level, above the knee, below the knee and at the ankle level. An ABI is obtained by dividing the Segmental ankle systolic pressure by the brachial systolic pressure. The usual index recorded should be 1 or just slightly higher. A gradient of 40 mm Hg or greater between the levels being compared suggests an occlusion or highly stenotic segment.

ABI READING	INDICATION
0.9 to 1.3	Normal Reading
0.4 to 0.9	Intermittent Claudication present
0.25 to 0.4	Rest Pain Present
Below 0.25	Ulcer, Gangrene

TOE PRESSURES:

Absolute Toe pressures provide a highly accurate method for determining the likelihood of success in the healing of an ulcer or in minor amputation, thus preventing a more proximal, major, potentially disabling amputation.

OTHER INVESTIGATIONS INCLUDE:

Exercise stress testing

Regional Tissue oxygen perfusion measurements ($TCPO_2$)

Laser Doppler Velocimetry

Duplex ultrasound evaluation

For Traumatic Amputations:

I) X – Ray

II) CT, MRI, Arteriography / Venography - if necessary

TREATMENT

Stages of Rehabilitation Program in Amputee

1. Pre-amputation counseling
2. Amputation surgery
3. Acute post – amputation period
4. Pre Prosthesis training
5. Preparatory Prosthesis fitting
6. Prosthesis fitting and training
7. Reintegration to the community
8. Long term follow – up

Pre – amputation Counseling

During this stage, it is essential to develop direct communication involving the patient, the family and the surgeon regarding the need for amputation and the expected surgical outcome.

Communication with the physiatrist, therapists and other members of the team should be facilitated.

Introductory discussions about phantom limb sensation, prosthetic devices, prosthesis fitting and training and timing of these events should be held.

When possible, a demonstration of prosthesis by a trained volunteer with a similar level of amputation and discussion of realistic expected functional outcomes should be arranged.

Amputation Surgery:

Ambi means around

Putatio means trimming

Amputation is done when all other modalities are explored, evaluated and rejected and the evidence suggests that the amputation is the best solution to the patient's plight.

Amputation is to achieve:

a) Most distal level with clinical condition
b) Well healed stump
c) Less functional loss
d) Less energy for ambulating with prosthesis

AMPUTATION SURGERY INCLUDES

a) Removal of a part or whole limb to exclude pathology

b) Reconstruction to create a best possible stump.

SURGICAL DECISION MAKING

- Retention of maximum limb length by amputation at distal most suitable level
- Optimum function is usually the primary concern
- No added benefit to having both lower limbs amputated at the same level

Amputation cosmesis of the prosthetic limb replacement must also be considered:

- in the Geriatric age group the patients activity level, ambulatory potential, cognitive skills, vision and overall medical condition must be evaluated.
- Most unilateral transtibial amputees who were successful prosthetic ambulators will master bilateral amputee gait if a transtibial or most distal amputation can be performed on the contralateral limb.

- In Non-ambulatory patients, the goal is to obtain wound healing, minimize complications and improve sitting balance, transfer and nursing care.
- Careful pre-operative assessment of the patients potential and setting realistic goals can help distinct surgical level selection and post operative rehabilitation wisely.

AMPUTATION SURGERIES

As in other specialized surgery, certain basic principles are peculiar to amputation surgery

TOURNIQUET

Except in ischemic limbs the use of a tourniquet is highly desirable and makes the amputation easier. Usually the limbs should be exsanguinated by wrapping if with a bandage before the tourniquet is inflated.

LEVEL OF AMPUTATION

With modern total contact sockets and sophisticated prosthetic fitting techniques, the level of amputation is less important. Rather any well healed, non tender, and properly constructed amputation stump can now be

satisfactorily fitted with prosthesis. The amputation should be through tissues that will heal satisfactorily and a level that will remove the diseased or otherwise abnormal part. The cardinal rule is to preserve all possible length consistent with good surgical judgement.

SKIN FLAPS:

The Stump should be covered with good skin which is more important. The skin at the end of the stump should be mobile and normally sensate. The scar should not be adherent to the underlying bone. Redundant soft tissues or large dog – ears also create problems in prosthetic fitting.

MUSCLES:

In myoplastic amputations or those using tension myodesis the muscle should be divided at least 5 cm distal to the level of intended bone section, then they are sutured to the bone or to apposing muscle groups under appropriate tension and then trimmed to a suitable length. Myodesis is specifically contraindicated in peripheral Vascular disease. In peripheral vascular disease, **Burgess Technique** is used, where a long posterior myocutaneous flap is taken to cover the residual limb in order to preserve the blood supply.

NERVES:

Nerves should be gently pulled distally into the wound and divided cleanly with a sharp knife so that the cut end retracts well proximal to the level of bone section.

BLOOD VESSELS:

Major blood vessels should be isolated and individually ligated with absorbable or non-absorbable sutures before being divided.

BONE:

Excessive periosteal stripping is contraindicated and may result in the formation of ring sequestra the closing of medullary canal at the end of bone by osteoperiosteal flaps to maintain normal pressure gradients within the canal is advised. There is also a proposal of creating a Synostosis between the tibia and fibula to prevent abnormal diversion of these bones during walking.

POST – OPERATIVE CARE

Short term post surgical goals might:

- Reduce or prevent post operative edema and promote healing of the residual limb.
- Prevent contractures and other complications.
- Increase strength in the affected lower extremity
- Increase strength in the remaining extremities
- Assist with adjustment to the loss of a body part
- Regain independence in mobility and self care.
- Learn proper care of the other extremity.

FACTORS THAT MIGHT AFFECT ATTAINMENT OF THE GOALS INCLUDE:

i) The patient's Vascular status

ii) The patient's Physiological age

iii) Diabetes

iv) Cardio Vascular disease

v) Visual impairment

vi) Limitation of Joint motion

vii) Muscular Weakness

POST OPERATIVE CARE:

The Stump is maintained postoperatively by

1) Soft dressing
2) Rigid dressing
3) Crepe bandaging
4) Controlled environment method
5) Immediate post operative prosthetic fitting

1. SOFT DRESSING

Advantages:

i) Allows inspection of wound

ii) Allows near normal range of movement

Disadvantages:

i) Does not prevent contractures

ii) Does not prevent trauma.

2. RIGID DRESSING:

Post operative rigid dressing in the form of plaster cast. It is called immediate post operative Rigid Dressing (IPORD).

Advantages:

i) Pain is decreased

ii) Wound heals quickly

iii) Edema is prevented

iv) Prevent contractures

v) Protects from trauma

Disadvantages:

i) Requires careful application

ii) Wound inspection cannot be done

3. CREPE BANDAGING

Bandaging is done like “Figure of 8”. It needs frequent rewrapping. This gives pressure from distal to proximal thus reducing hematoma and edema.

4. CONTROLLED ENVIRONMENT METHOD

It uses a machine that supplies bacteria free environment to the wound with a controlled humidity and temperature. This provides perfect environment for primary healing.

5. IPOPF

IPOPF can be done especially in children and clean traumatic ablations.

POST OPERATIVE PROGRAMME IN AMPUTEE TRAININGS:

In the first few post operative days it is difficult for the bilateral amputee to move about in bed. The bed should have been prepared pre-operatively with cot sides, monkey pole and pressure relief aids. The essential activities which need to be taught by the physiotherapist from the first post operative day are

i) sitting up in bed

ii) Balance

iii) Bed mobility

iv) Transfers

i) Sitting up in bed

This must be achieved by the patient pushing down on the bed with arms one at a time and rotating the trunk a quarter turn to one side then a quarter turn to other.

The monkey pole is useful for lifting up onto bedpans and for pressure area care.

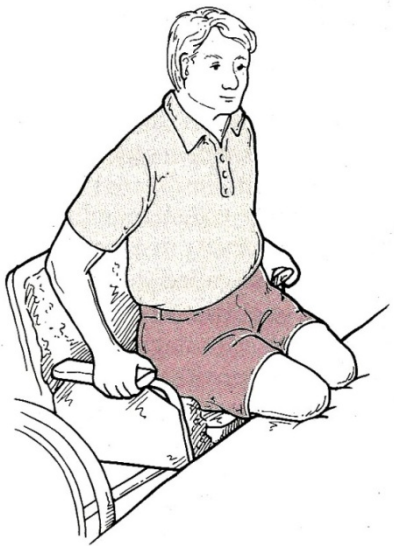
It is very common for bilateral amputees to overbalance backwards. Rythmic stabilizations in Unsupported sitting are the most useful exercises.

iii) Bed mobility

This is best achieved by the patient hip hitching in upright sitting and moving each buttock alternately. Forwards, backwards and sideways “walking” on the buttocks is practiced

iv) Transfers:

Backward transfer off the bed into a suitable wheel chair is taught. All bilateral amputees will require a wheelchair, irrespective of their age, condition and level of amputation. This wheel chair must have the rear wheels set back 7.5 cm to compensate for the alteration in weight distribution of the patient in the chair, owing to the loss of both lower limbs.



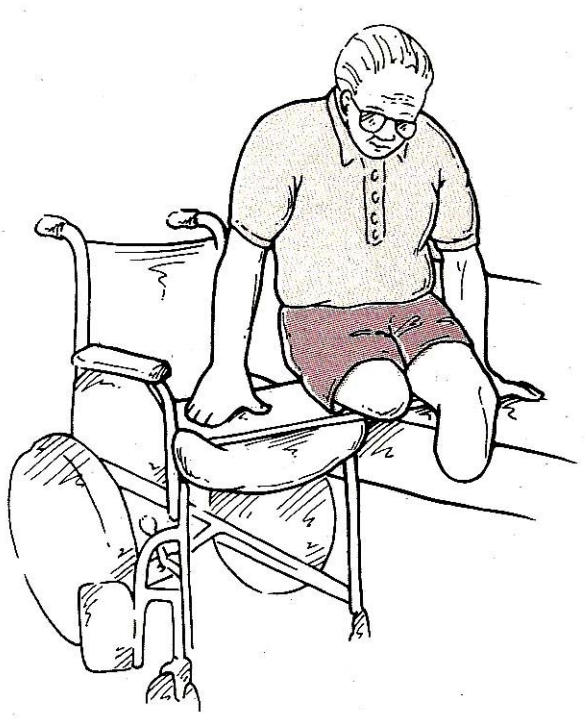
Success in these early activities and future potential for independent mobility will be based on four physical consideration:

i) Muscle Strength : Good upper limb and trunk strength

ii) Trunk mobility : a full range of movements in the joints and general flexibility is needed.

iii) Body proportions : those patients with a long trunk and short arms and those with large abdomens, will find mobility difficult.

iv) Medical Condition: Cardio – Vascular status, level of cerebral function and rate of deterioration in progressive conditions coil also affect mobility.



RESIDUAL LIMB ASSESSMENT PROFORMA

Demographic and Health Information Section:

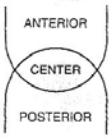
1. Date
2. Name
3. Address
4. Age
5. Height
6. Weight
7. Living Arrangements:
   ____ with family ____ alone ____ facility
8. Occupation (past/future plans)
9. Recreational Activities
10. Vocational Rehabilitation Potential
    ____ yes ____ perhaps ____ no
11. Date of amputation/site/reason
12. Date and Reason for Revision, if any
13. Past Medical History
14. Medications
15. Current Problems
16. Purpose/goal for prosthesis

Functional Assessment Section:

1. Ambulation
   ____ non ambulatory
   ____ community (independent indoors and outdoors on all surfaces)
   ____ household (independent mainly indoors and some outdoors if flat, smooth surfaces)
   ____ therapeutic (indoors under assistance or supervision or chairbound)
   ____ type of assistive device used
2. Transfers
   ____ independent
   ____ requires assistance (describe)
3. Bandaging
   ____ independent ____ with assistance
   ____ properly ____ needs improvement
   ____ not bandaging

Tests and Measures Residual Limb Condition Section:

1. Length from:
   ____ tibial tubercle (transtibial) to end of bone
   ____ tibial tubercle (transtibial) to end of soft tissue
   ____ ischial tuberosity (transfemoral) to end of bone
   ____ ischial tuberosity (transfemoral) to end of soft tissue
2. Circumference Measurements at:
   0cm ____ 4cm ____ 8cm ____
   12cm____ 16cm____ 20cm____
   24cm____ 28cm____ 32cm____
3. Shape of Residual limb
   ____ conical ____cylindrical ____bulbous
4. Distal view: Note areas of
   Tenderness (t) Adherence (a)
   Invagination (i) Callus (c)
   Discoloration (d) Non-healing (nh)



5. Condition of hip:

Abduction		Flexion		Extension		Adduction	
Strength	ROM	Strength	ROM	Strength	ROM	Strength	ROM

6. Condition of knee:

Flexion		Extension	
Strength	ROM	Strength	ROM

7. Stability:
   ____ anterior/posterior ____ medial/lateral
   ____ crepitus ____recurvatum
8. Skin condition
   ____ warm ____ abnormally warm
   ____ adherent scar ____ cool ____ impaired sensitivity ____ smallest Semmes-Weinstein Monofilament perceived (Inability to feel the touch of 5.07 or smaller indicates loss of protective extension)
9. Phantom pain/limb (describe)
10. Areas of possible complications (neuroma, redundant tissue)

Remaining Extremity Section

1. Strength
   ____ normal ____ decreased (describe)
2. ROM
   ____ normal ____ decreased (describe)
3. Vascular pulses:

Pulse	0 (absent)	1+ (diminished)	2+ (normal)	3+ (increased)
Femoral				
Tibial				
Posterior tibial				
Doral Pedis				

4. Refill time after blanching toenails ____ seconds. (Normal refill time is 3 seconds)
5. Temperature
   ____ abnormally warm ____ cool
6. Skin condition
   ____ warm ____ abnormally warm
   ____ cool ____ impaired sensitivity
   ____ smallest Semmes-Weinstein Monofilament perceived (Inability to feel the touch of 5.07 or smaller indicates loss of protective extension)
7. Extent of distal hair growth

Assessment

Outcomes

Signature Date

Figure 2-1. Examination of patients with an amputation.

PROSTHETIC STAGE

BILATERAL AMPUTATION PROSTETIC CONSIDERATION

- Bilateral Amputee do not have Non-involved or sound side to compensate for limitation of a prosthesis especially for the loss of Ankle motion.
- Multiaxial feet or Ankle used to be thought of contraindication for bilateral lower limb Amputee because it was felt that solid ankle system were necessary for the amputee to be able to stand stable within secure base support.
- Without sensory feedback, some individuals feel unsteady and they prefer solid Ankle system.
- Prosthetic alignment can be entrance stability in the bilateral Amputee.
- Prosthetic fitting can be placed further posterior and initial dorsiflexion to shift the individual centre of gravity during quick standing.
- Bilateral lower limb Amputations can choose their height few inches shorter so that can be helpful for allowing sit and stand easier. This also lower the centre of gravity little.

PROSTHETIC FITTING AND REHABILITATION

Rapid prosthetic rehabilitation of the multiple limb amputees ensures the best results in returning to an active independent life Style.

Contemporary prosthetic fitting of the bilateral lower limb amputee can be categorized into

i) Immediate post surgical prosthetic fitting.

ii) Early post surgical prosthetic fitting

iii) Preparatory prosthetic fitting and

iv) Definitive prosthetic fitting

Maturation of the residual limb by comfortably increasing weight bearing and initial gait training predominate in the preparatory prosthetic phase.

Cosmesis, durability and final gait training become important considerations in the definitive prosthetic phase.

i) Immediate post – surgical prosthetic fitting (IPPF)

Immediate post – surgical prosthetic fitting with controlled weight bearing is the initial patient treatment of choice, especially in the young traumatic amputee.

The primary consideration is achieving optimal would healing earlier, by means of controlling post surgical edema without restricting circulation.

Tissue support minimizes inflammatory reaction and reduces phantom pain, the Psychological benefits are significant as the patient wakes up with a prosthesis in place of the amputated limb and rehabilitation starts immediately. Use of a Tilt table is necessary for the bilateral amputee.

Actual ambulation activities are delayed until the incisions have healed and sutures have been removed. Patients with bilateral amputations must be advanced more slowly and carefully.

IPPF can be implemented in any hospital setting that has a trained team of professional available.

ii) Early Post – Surgical Prosthetic fitting

To delay rigid dressing until suture removal is very common in the bilateral amputee.

Frequent cast changes may be indicated when there is considerable evidence of edema at the time of initial application of the cast socket. If a cast socket inadvertently comes off the limb, it should not be pushed back on. A new socket must be applied without delay. Removable cast sockets have been unsuccessful.

Regular interval full cast changes between 7 and 10 days are adequate for dressing changes unless would problems require more frequent attention.

Soft compression dressings supplemented by an elastic bandage or shrinker sock are less effective in achieving rapid wound healing.

iii) Preparatory Prosthetic fitting

It is also referred to as intermediate or training prostheses.

They are useful if the volume of residual limb is expected to decrease rapidly in the near future or if a gradual reduction of joint contractures will require repeated prosthetic realignment. It is useful to evaluate a patient's potential to safely ambulate or to demonstrate to a patient the energy and skill requirements associated with the use of prostheses.

The component choice is carefully prescribed in consideration of the particular patients needs.

It is frequently prudent to utilize definitive foot – shin-knee components for the preparatory prosthesis carry them over into the definitive device.

iv) Definitive prosthetic fitting

Improved biomechanical fitting principles and static and dynamic test socket procedures combined with flexible socket construction further enhance patient comfort and acceptance.

Individual patient needs vary greatly among infants, children, adolescents, adults and geriatric patients.

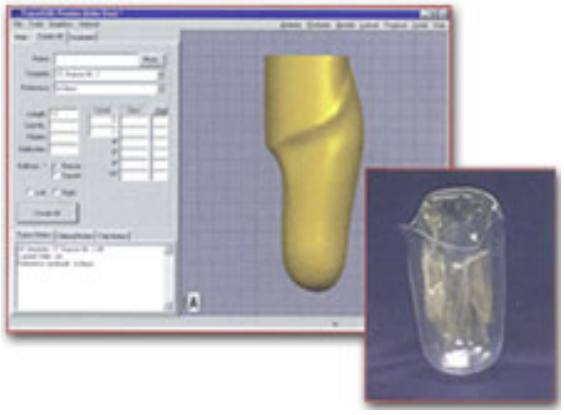
A patient must learn to walk before he can expect to run, if this is even physically possible.

COMPONENT SELECTION

High strength, light weight components made from Titanium and carbon fibers combined with sockets fabricated with thermoplastic materials or acrylic resins results energy consumption during ambulation activities.

Improved biomechanical fitting principles and static and dynamic test socket procedures combined with flexible socket construction further entrance patient comfort and acceptance.

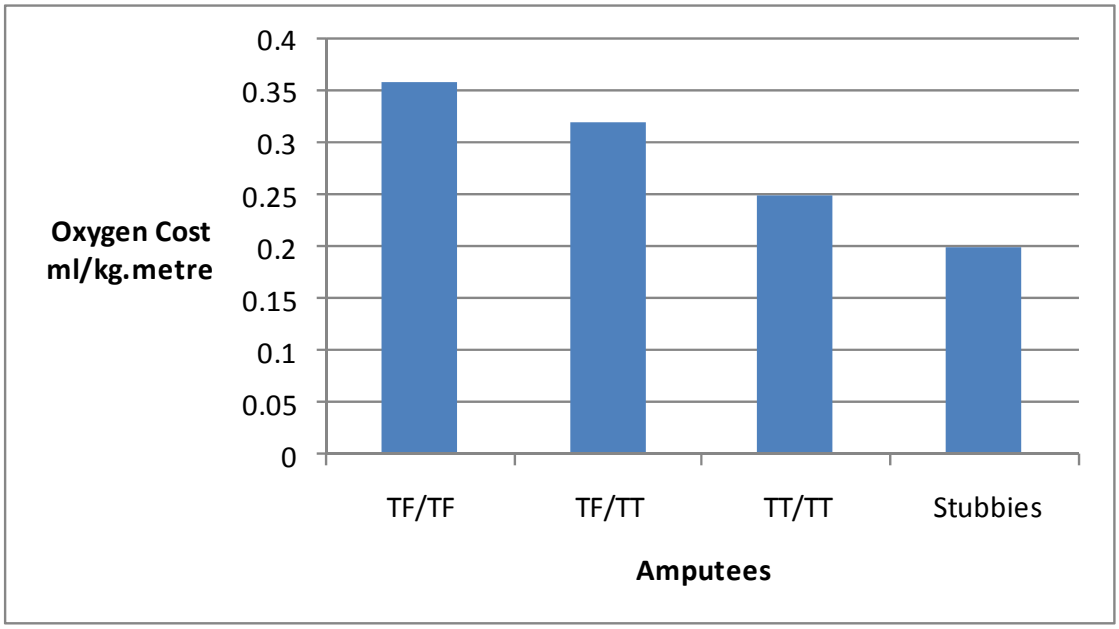
CAD – CAM (Computer Aided design and computer Aided Manufacture) open the door to new and exciting possibilities to better serve the multiple limb amputee.



Individual patient needs vary greatly among Infants, children, adolescents, adults, athelets and active and sedentary geriatric amputees.

ENERGY COST

Patients with dysvascular amputation have lower energy reserves and expend more effort in walking than of those with traumatic amputation, Long terms use of bilateral transfemoral prostheses is uncommon but not impossible, for elderly patients with dysvascular amputation, In contrast, a significant number of those with traumatic bilateral transfemoral amputation successfully use prosthesis long term interestingly, bilateral transtibial prosthesis require less effort that a unilateral transfemoral prosthesis.



The effect of a amputation on the energy cost of ambulation is significant. Typically, the “Cost” of Gait is measured in oxygen consumption. The Volume of air inhaled and the amount of carbon dioxide exhaled is used to calculate energy expenditure. In addition ot oxygen consumption and rate, maximal aerobic capacity influences and individuals ability to prefer with a prosthesis.

Vascular amputees have higher oxygen consumption per distance than traumatic amputees.

A bilateral vascular transtibial amputee has a walking speed of 40 m/min at an oxygen cost 107% greater than normal.

A bilateral traumatic transfemoral amputee walking at a reduced speed of 54 m/min had a reported oxygen cost that was 120% greater than normal.

Physiological cost Index (PCI) can also be used as an estimate of the energy cost of ambulation.

$$PCI = \frac{\text{Walking Heart Rate} - \text{Resting Heart Rate}}{\text{Walking Speed in Metre/Min}}$$

Normal Range is 0.12 to 0.45

PROSTHESES FOR VARIOUS LEVELS AND COMBINATIONS OF AMPUTATION

BILATERAL TRANSFEMORAL AMPUTATION – PROSTHETIC CONSIDERATION

Here, one of the primary goals of prosthetic prescription is stability in the stance phase of Gait. One of the most effective prosthetic components for stance phase stability during level walking is a polycentric knee unit .

The use of “STUBBIES” as the initial prosthesis is recommended for all Transfmoral amputees, regardless of age who are considered candidates for ambulation and who lost both legs simultaneously.

- STUBBIES consists of prosthetic sockets mounted directly over rocker – bottom platforms that serve as feet.

- The rocker bottom platform have a long posterior extension to prevent the tendency for the patient to fall backward initially.
- The shortened anterior portion allows smooth roll over into the push – off phase.
- There are no knees in the stubbies
- The use of stubbies results in lowering of the centre of gravity and the rocker bottom provides a broad base of support that teaches trunk balance and provides stability and confidence to the patient during standing and ambulation.
- The energy required to ambulate while wearing stubbies can be generated without needing assistive devices such as crutches or canes. Stubbies also have the advantage of decreasing hip flexion contracture and allowing the physiologic effects of being upright.
- Initially, the stubbies is use. Since there are no knees in the stubbies, the user does not have to concentrate on controlling the prosthetic knee and preventing the knee from flexing. Patients begin by focusing on socket fit and basic ambulation skills.
- As the progress is made, the devices are raised to greater height, the feet are reversed to a forward pointing direction and the knee units are added one at a time.

- Eventually, the devices are raised to the desired final height and the amputee can progress to using knees with less inherent stability, as well as using less restrictive gait aids.
- For those patients who have the potential to walk at varying speeds, the addition of fluid swing phase control is recommended.

- In recent years, microprocessor – controlled hydraulic knees offering both stance and swing phase control have been well received clinically by this population. The risk of injury in a fall is greater if locking or stance control knees are used in both prosthesis. Single axis knees are stabilized by muscle control and postural response at hip. Bilateral single – axis knees are often difficulty to use safety in older adults with dysvascular amputation.

- Bilateral polycentric (four bar linkage) knees offer maximum stance phase stability. This knee has the advantage of shortening during swing phase, thus helping to improve toe clearance.
- Ankle – foot components that emphasize stability and standing balances are typical for this group with bilateral loss. Single axis or multiaxial foot become easier to the control if patient leans forward slightly, shifting the centre of gravity forward so that the weight line falls anterior to the ankle axis at all times eliminating the risk of falling backward.
- Ancillary components, such as torque absorbers often make walking easier and more comfortable for patients with bilateral transfemoral amputation. Locking rotation devices make many activities of daily living easier to accomplish.

BILATERAL TRANSTIBIAL AMPUTATION – PROSTHETIC CONSIDERATION

Most patients with bilateral amputation are concerned about falling backward. The prosthetist often chooses to use a slightly stiffer heel resistance to minimize the risk of backward falls.

Active patients walk well with elastic keel and dynamic response feet or with multiaxial designs as long as they have sufficient strength and postural responses to manage these flexible components.

Patient preference is an important consideration in prosthetic prescription. The consideration of ancillary components such as torque absorbers or stock absorbing pylons, is important for all patients with bilateral amputation.

Lessening the weight of the prostheses, particularly at the ankle foot area, is also important because lighter weight prostheses are easier to control and increase acceptance of the device.

Individuals with Bilateral Transtibial Amputations are often fit with patellar Tendon Bearing socket with supra condylar cuff suspension or a Total surface bearing socket with roll – on silicone linear suction suspension. Bilateral endoskeletal rather than exoskeletal prostheses are common with both Transtibial and Tranfemoral amputees, because of lighter weight, more easily interchanged components and better cosmetic appearance.

COMBINATION OF TRANSFEMORAL AND TRANSTIBIAL AMPUTATION

Here, the preservation of one biological knee makes prosthetic use much easier and successful ambulation more likely.

For most patients the Transtibial side is the propulsive and balance limb and the transfemoral side supplements these functions. On the basis of these functional differences, the prosthetist may choose to use different prosthetic feet.

SPECIAL CONSIDERATION IN SOCKET DESIGN AND SUSPENSION FOR BILATERAL AMPUTATION

The person with bilateral limb loss is constantly bearing full weight on artificial limbs while walking or standing, All options to increase skin protection and comfort should be actively considered and suspension must be as secure as possible. A soft insert and flexible socket may be used to enhance comfort during wear and reduce the likelihood that shear forces will be problematic for the skin suction suspension with silicone sleeves or inserts should be considered for the majority of patients with bilateral amputation. Supracondylar cuff suspension are typically used in trastibial prostheses. Silesian belts are often used in transfemoral designs. Incease of Bilateral prostheses. Suspension belts are usually integrated into a single assembly.

Ischial containment sockets are as effective for patients with bilateral amputation at the transfemoral level as they are for patients with a single transfemoral amputation.

SPECIAL CONSIDERATIONS

INFANT AMPUTESS

Children with congenital limb deficiencies present major challenge to the entire rehabilitation team. Early diagnosis, surgical intervention and prosthetic fitting have been advocated. Miniaturized, commercially available prosthetic components are very limited for infants. This requires the prosthetist to design and custom fabricate what is needed.

CHILD AMPUTEES

Durability must be considered in the design for this active group of amputees. Introduction of new petro chemical based materials that are light weight and strong has met the challenge of prosthetic durability. Comfort and control of the prosthesis are directly proportional to good socket retention on the residual limb.

ASOLESCENT AND YOUND ADULT AMPUTEES

These group of amputees should be allowed to evaluate different socket designs, knee components and feet to determine the best functional combination for their needs.

Suction suspension is preferable for bilateral amputees so long as the amputee is able to don and doff the prosthesis effectively without assistance

Flexible birm, Ischial containment transfemoral sockets provide more comfort during ambulation and when seated by providing increased clearance in the perineum.

Special foot alignment and resistance is required for the bilateral amputee for security and balance.

For maximum durability, exoskeletal design has the advantage over endoskeletal systems.

Different knee mechanisms can and stocked be utilized as required, but they must be tested and evaluated during trial ambulation.

GERIATRIC AMPUTEES

The Great majority of bilateral lower limb amputees today are the elderly who lose their limbs secondary to Diabetes and Vascular disease between the ages of 55 and 95 years. The challenge of rehabilitating these patients is frequently complicated by the presence of other illnesses. Chronological age alone should not determine whether an amputee is a prosthetic candidate.

Preoperative and postoperative education is an important adjunct to rehabilitation. Older patients require much more time, understanding, patience and encouragement. Prosthesis design and componetry must be based on careful individual evaluation of all pertinent factors. Socket design must be such that the patient can don and doff the prosthesis independently. Prosthesis for Geriatric amputees should be made as light as possible with contemporary techniques.

RE-INTEGRATION INTO THE COMMUNITY

The aim of rehabilitation is to achieve optimal independce in mobility and self care activities and to overcome physical, psychological, Social and

Vocational problems. Tailor – made programmes for each person addressing the specific needs to be looked into.

Family's acceptance to change and modify the home environment to suit to the specific needs of the amputee and ability to manage the mobility aids such as wheel chair or prostheses need to be address prior to his discharge.

For educational age group, focus should be on the strengthening to face systemic challenges and environmental barriers.

For the employable group, Vocational guidance and counseling followed by Vocational evaluation, on the job evaluation with workplace adjustments and suitable job placements are to be incorporated into the rehabilitation plan.

If the person is a home maker, the rehabilitation is to focus on how she can manage the affairs of the home such as child-rearing cooking etc.

The steps to go through this treacherous path to equip the person to be self reliant are:

i) To Improve the support system

ii) To Get involved in physical activity (exercise and self – care)

iii) To Join a Self – help group of person in similar situations

iv) To obtain professional guidance and counseling

v) To rebuild the sense of well – being, purpose and achieve dignity and worth

vi) community re-integration

Day Hospital Rehabilitation Programme

Patient participates in rehabilitation in hospital 6 hours per day, 5 days a week and return home every evening and weekend. It is then followed by modified and restricted work and then made to return to normal work.

LONG TERM FOLLOW UP

Regular follow ups are mandatory for any successful rehabilitation. Also, scheduled visits to the rehabilitation centre help in addressing certain issues that might crop up every now and then. The team members are to deal with these depending upon the nature of the problems.

MATERIALS AND METHODS

Rehabilitation outcome of 20 cases of Bilateral lower limb Amputees of different etiology, level and age group has been studied in Government Institute of Rehabilitation Medicine, K.K. Nagar, Chennai – 83.

The Following criteria has been used to assess the functional outcome of Bilateral lower limb amputees.

i) Ambulation status

ii) Stump Pain

iii) Phantom Pain

iv) Psychological

v) Re-Integration into the community

S.No	Case	Age / Sex	ETIOLOGY	LEVEL OF AMPUTATION	PROSTHETIC PRESCRIPTION
1	No.1	35/F	TRAUMA	BILATERAL BK	BILATERAL PTB PROSTHESES
2	No.2	38/M	TRAUMA	RIGHT – AK , LEFT – BK,	RIGHT – AK PROSTHESIS LEFT – PTB PROSTHESIS
3	No.3	26 /M	TRAUMA	BILATERAL AK	BILATERAL AK PROSTHESES
4	No.4	55/M	TRAUMA	RIGHT – AK , LEFT – BK,	RIGHT – AK PROSTHESIS LEFT –BENT KNEE PROSTHESIS
5	No.5	56/M	VASCULAR	BILATERAL AK	STUBBIES, BILATERAL AK PROSTHESES

S.No	Case	Age / Sex	ETIOLOGY	LEVEL OF AMPUTATION	PROSTHETIC PRESCRIPTION
6	No.6	22/F	VASCULAR(POPLITEAL)	BILATERAL BK	BILATERAL BK PROSTHESES
7	No.7	38/M	TRAUMA(RTA)	BILATERAL AK	STUBBIES, BILATERAL AK PROSTHESES
8	No.8	60 /M	TRAUMA	BILATERAL AK	BILATERAL AK PROSTHESES
9	No.9	32/M	RTA	BILATERAL AK	BILATERAL AK PROSTHESES
10	No.10	47/M	RTA	BILATERAL AK	BILATERAL AK PROSTHESES
11	No.11	27/M	NEUROPATHIC JOINT DUE TO MENINGOMYELOCELE	BILATERAL THROUGH KNEE	BILATERAL THROUGH KNEE PROSTHESES
12	No.12	22/M	RTA	BILATERAL BK	RIGHT- PTB PROSTHESIS,LEFT-CONVENTIONAL PROSTHESIS
13	No.13	52/M	TRAIN ACCIDENT	RIGHT-BK,LEFT-AK	RIGHT – PTB PROSTHESIS,LEFT – AK PROSTHESIS

S.No	Case	Age / Sex	ETIOLOGY	LEVEL OF AMPUTATION	PROSTHETIC PRESCRIPTION
14	No.14	22/M	RTA	BILATERAL BK	BILATERAL PTB PROSTHESES
15	No.15	60/M	VASCULAR	RIGHT –AK,LEFT -BK	RIGHT –AK PROSTHESIS, LEFT –PTB PROSTHESIS
16	No.16	23/M	TRAUMA	RIGHT –AK, LEFT -BK	RIGHT –AK PROSTHESIS, LEFT –PTB PROSTHESIS
17	No.17	36/M	VASCULAR	BILATERAL AK	BILATERAL AK PROSTHESES
18	No.18	31/M	TRAUMA	BILATERAL AK	BILATERAL AK PROSTHESES
19	No.19	22/F	VASCULAR	BILATERAL BK	BILATERAL PTB PROSTHESES
20	No.20	65/M	RTA	BILATERAL BK	BILATERAL PTB PROSTHESES

NOTE : AK = ABOVE KNEE

BK = BELOW KNEE

PTB = Patellar Tendon Bearing

CASE NO	AMBULATION STATUS	STUMP PAIN	PHANTOM PAIN	PSYCHOLOGICAL	RE-INTEGRATION INTO THE COMMUNITY
1	VI	-	+	DEPRESSION	GOOD
2	V	+	+	DEPRESSION	GOOD
3	V	-	-	DENIAL	FAIR
4	V	-	+	DEPRESSION	NO FOLLOW-UP
5	IV	+	-	ANGER	POOR
6	VI	-	-	DENIAL	GOOD
7	V	-	+	ACCEPTANCE	GOOD
8	IV	+	+	DEPRESSION	POOR
9	V	-	+	HOPE	FAIR
10	IV	+	+	DEPRESSION	FAIR

CASE NO	AMBULATION STATUS	STUMP PAIN	PHANTOM PAIN	PSYCHOLOGICAL	RE-INTEGRATION INTO THE COMMUNITY
11	V	-	-	DEPRESSION	FAIR
12	VI	-	+	ACCEPTANCE	GOOD
13	IV	+	+	DEPRESSION	FAIR
14	VI	-	+	HOPE	GOOD
15	IV	+	+	DEPRESSION	FAIR
16	V	+	-	ACCEPTANCE	GOOD
17	IV	-	-	HOPE	GOOD
18	IV	-	+	ACCEPTANCE	FAIR
19	VI	+	-	DENIAL	FAIR
20	V	+	+	DEPRESSION	FAIR

NOTE : AMBULATION LEVELS OF LOWER EXTREMITY AMPUTEES

VI - Unlimited Community Ambulation

V - Limited Community Ambulation

IV - Unlimited House Hold Ambulation

III - Limited House Hold Ambulation

II - Supervised House Hold Ambulation

I - Wheel Chair Ambulation

0 - Bed ridden

OUTCOME BASED ON DIFFERENT AMPUTATION LEVELS

Amputation Level	OUTCOME			
	Good	**Fair**	**Poor**	**No-follow up**
Bilateral AK	2	4	2	-
Bilateral BK	4	3	-	-
AK vs BK	2	2	-	1

OUTCOME BASED ON DIFFERENT AGE GROUPS

Age Group	OUTCOME			
	Good	**Fair**	**Poor**	**No-follow up**
0 – 18 yrs	-	-	-	-
18 – 40 yrs	8	5	-	-
41 – 60 yrs	-	3	2	1
> 60 yrs	-	1	-	-

OBSERVATION AND CONCLUSION

1. The person with Simultaneous bilateral lower limb amputation will encounter difficulty in using prostheses when compared to a person who had one limb amputation first followed by another limb amputation after some interval

2. Higher the level of amputation the prosthetic fitting becomes difficult because of
   i. Complexity of the prosthesis
   ii. Increased weight of the prosthesis
   iii. Increased energy expenditure

3. The individuals who has got effective trunk balance, Good upper body strength, Good sense of balance, effective muscle control and with the ability to transfer will have a better outcome.

4. The younger age group people will have a better outcome when compared to the Geriatric age group who will have a co-morbid illness.

5. The person with amputation due to Trauma will have a good rehabilitation outcome and Re-integration into the community when compared to the amputation due to dysvascular disease

6. The socket design, suspension methods and component selection at Ankle – foot, Knee level will play a major role in the prosthetic fitting and rehabilitation.

7. Experienced clinical team in a supportive setting is essential for successful rehabilitation

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PROFORMA

Demographic and Health Information Section:

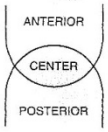
1. Date
2. Name
3. Address
4. Age
5. Height
6. Weight
7. Living Arrangements:
   ____ with family ____ alone ____ facility
8. Occupation (past/future plans)
9. Recreational Activities
10. Vocational Rehabilitation Potential
    ____ yes ____ perhaps ____ no
11. Date of amputation/site/reason
12. Date and Reason for Revision, if any
13. Past Medical History
14. Medications
15. Current Problems
16. Purpose/goal for prosthesis

Functional Assessment Section:

1. Ambulation
   ____ non ambulatory
   ____ community (independent indoors and outdoors on all surfaces)
   ____ household (independent mainly indoors and some outdoors if flat, smooth surfaces)
   ____ therapeutic (indoors under assistance or supervision or chairbound)
   ____ type of assistive device used
2. Transfers
   ____ independent
   ____ requires assistance (describe)
3. Bandaging
   ____ independent ____ with assistance
   ____ properly ____ needs improvement
   ____ not bandaging

Tests and Measures Residual Limb Condition Section:

1. Length from:
   ____ tibial tubercle (transtibial) to end of bone
   ____ tibial tubercle (transtibial) to end of soft tissue
   ____ ischial tuberosity (transfemoral) to end of bone
   ____ ischial tuberosity (transfemoral) to end of soft tissue
2. Circumference Measurements at:
   0cm ____ 4cm ____ 8cm ____
   12cm____ 16cm____ 20cm____
   24cm____ 28cm____ 32cm____
3. Shape of Residual limb
   ____ conical ____ cylindrical ____ bulbous
4. Distal view: Note areas of
   Tenderness (t) Adherence (a)
   Invagination (i) Callus (c)
   Discoloration (d) Non-healing (nh)



5. Condition of hip:

Abduction		Flexion		Extension		Adduction	
Strength	ROM	Strength	ROM	Strength	ROM	Strength	ROM

6. Condition of knee:

Flexion		Extension	
Strength	ROM	Strength	ROM

7. Stability:
   ____ anterior/posterior ____ medial/lateral
   ____ crepitus ____ recurvatum
8. Skin condition
   ____ warm ____ abnormally warm
   ____ adherent scar ____ cool ____ impaired sensitivity ____ smallest Semmes-Weinstein Monofilament perceived (Inability to feel the touch of 5.07 or smaller indicates loss of protective extension)
9. Phantom pain/limb (describe)
10. Areas of possible complications (neuroma, redundant tissue)

Remaining Extremity Section

1. Strength
   ____ normal ____ decreased (describe)
2. ROM
   ____ normal ____ decreased (describe)
3. Vascular pulses:

Pulse	0 (absent)	1+ (diminished)	2+ (normal)	3+ (increased)
Femoral				
Tibial				
Posterior tibial				
Doral Pedis				

4. Refill time after blanching toenails ____ seconds. (Normal refill time is 3 seconds)
5. Temperature
   ____ abnormally warm ____ cool
6. Skin condition
   ____ warm ____ abnormally warm
   ____ cool ____ impaired sensitivity
   ____ smallest Semmes-Weinstein Monofilament perceived (Inability to feel the touch of 5.07 or smaller indicates loss of protective extension)
7. Extent of distal hair growth

Assessment

Outcomes

Signature Date

Figure 2-1. Examination of patients with an amputation.

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